CLAIMS

What is claimed is:

1. A method of tracking coded objects that are located within a physical system and are represented within an image, the method comprising the acts of:

receiving a first image having a plurality of image pixels that include a first pixel, a first neighbor pixel, and a plurality of coded objects pixels that include the first pixel, wherein the coded object pixels represent a first coded object of the physical system that has a known code pattern;

obtaining object data about the first coded object by comparing luminosity values of the first pixel and the first neighbor pixel.

2. The method recited in claim 1, wherein the object data specifies a pixel of the plurality of pixels as being a reference pixel within the first coded object that has the known code pattern.

3. The method recited in claim 2, wherein the act of obtaining the object data is further comprised of the acts of:

comparing luminosity values of the first pixel and a first group of neighbor pixels of the plurality of pixels;

determining a first count of the first group neighbor pixels that have a luminosity value that is lower than a first pixel luminosity value of the first pixel;

determining whether the first count is more than a predetermined number; and

defining the first pixel as the reference pixel of the first code object when the first count is more than the predetermined number.

4. The method recited in claim 2, wherein the act of obtaining the object data is further comprised of the acts of:

comparing luminosity values of the first pixel and a first group of neighbor pixels of the plurality of pixels;

determining a first count of the first group neighbor pixels that have a luminosity value that is lower than a first pixel luminosity value of the first pixel;

comparing luminosity values of a second pixel and a second group of neighbor pixels of the plurality of pixels;

determining a second count of the second group neighbor pixels that have a luminosity value that is lower than a second pixel luminosity value of the second pixel;

determining whether the second count is more than a predetermined number;

defining the first pixel as the reference pixel of the first code object when the first count is higher than the second count; and

defining the second pixel as the reference pixel of the first code object when the second count is higher than the first count.

5. The method recited in claim 1, wherein the object data indicates a position of the first pixel.

6. The method recited in claim 5, wherein the act of obtaining the object data is further comprised of the acts of:

comparing luminosity values of a first region of pixels of the plurality of pixels to determine a minimum value position of a selected pixel of the first region that has a minimum luminosity value that is lower than any other pixel of the first region, wherein the region includes the first pixel, the first pixel having a black color and the other pixels of the region having a white color; and

defining the position of the first pixel as being at the minimum value position within the first region.

7. The method recited in claim 5, wherein the act of obtaining the object data is further comprised of the acts of:

comparing luminosity values of a first region of pixels of the plurality of pixels to determine a maximum value position of a selected pixel of the first region that has a maximum luminosity value that is higher than any other pixel of the first region, wherein the region includes the first pixel, the first pixel having a white color and the other pixels of the region having a black color; and

defining the position of the first pixel as being at the maximum value position within the first region.

8. The method recited in claim 5, wherein the object data further indicates a position of a second pixel, the first pixel being black and the second pixel being white.

9. The method recited in claim 8, wherein the act of obtaining the object data is further comprised of the acts of:

subtracting the luminosity value of each pixel of the plurality of pixels that is positioned within a defined white region from an associated pixel of the plurality of pixels that is positioned in a defined black region, the pixels of the defined white region being mostly white except for the first pixel and the pixels of the defined black region being mostly black accept for the second pixel;

determining a minimum subtraction position for the pixels that result in a lowest subtraction result; and

defining the position of the first pixel and the second pixel as being at the minimum subtraction position within the white region and the black region.

10. The method recited in claim 5, wherein the position of the first pixel indicates the position of the first coded object.

11. The method recited in claim 5, wherein the position of the first pixel indicates the position of a movable object within the first coded object.

12. The method recited in claim 1, wherein the object data indicates whether the first pixel is black or white.

13. The method recited in claim 12, wherein the first neighbor pixel is a known white pixel and the object data is obtained by the acts of:

determining whether a first pixel luminosity value of the first pixel is smaller than a first neighbor luminosity value of the first neighbor pixel by more than a predetermined value;

defining the first pixel as black when the first pixel luminosity value of the first pixel is smaller than the first neighbor luminosity value of the first neighbor pixel by more than a predetermined value; and

defining the first pixel as white when the first pixel luminosity value of the first pixel is not smaller than the first neighbor luminosity value of the first neighbor pixel by more than a predetermined value.

14. The method recited in claim 12, wherein the act of obtaining the object data is further comprised of the acts of:

comparing luminosity values of the first pixel and a second neighbor pixel of the plurality of pixels, wherein the first neighbor pixel and the second neighbor pixel are known white pixels; and

determining whether the first pixel luminosity value of the first pixel is smaller than a maximum value luminosity of the first neighbor pixel and the second neighbor pixel by more than a predetermined value.

15. The method recited in claim 14, wherein the act of obtaining the object data is further comprised of the acts of:

defining the first pixel as black when the first pixel is smaller than a maximum value luminosity of the first neighbor pixel and the second neighbor pixel by more than a predetermined value; and

defining the first pixel as white when the first pixel luminosity value of the first pixel is not smaller than a maximum value luminosity of the first neighbor pixel and the second neighbor pixel by more than a predetermined value.

16. The method recited in claim 14, wherein the act of obtaining the object data is further comprised of the acts of:

determining whether a first pixel luminosity value of the first pixel is smaller than a minimum value luminosity of the first neighbor pixel and the second neighbor pixel by more than zero; and

defining the first pixel as white when the first pixel luminosity value of the first pixel is smaller than a maximum value luminosity of the first neighbor pixel and the second neighbor pixel by more than the predetermined value; and

defining the first pixel as black when the first pixel luminosity value of the first pixel is not smaller than a maximum value luminosity of the first neighbor pixel and the second neighbor pixel by more than the predetermined value and when the first pixel luminosity value of the first pixel is smaller than the minimum value by more than zero.

17. The method recited in claim 12, wherein the act of obtaining the object data is further comprised of the acts of:

comparing luminosity values of the first pixel and a second neighbor pixel of the plurality of pixels, wherein the first neighbor pixel is a known white pixel and the second neighbor pixel is a known black pixel; and

determining whether a first pixel luminosity value of the first pixel is smaller than a first neighbor luminosity value of the first neighbor pixel by more than a second neighbor luminosity value the second neighbor pixel is smaller than the first pixel luminosity value of the first pixel;

defining the first pixel as black when the first pixel luminosity value of the first pixel is smaller than the first neighbor luminosity value of the first neighbor pixel by more than the second neighbor luminosity value of the second neighbor pixel is smaller than the first pixel luminosity value of the first pixel; and

defining the first pixel as white when the first pixel luminosity value of the first pixel is not smaller than the first neighbor luminosity value of the first neighbor pixel by more than the second neighbor luminosity value of the second neighbor pixel is smaller than the first pixel luminosity value of the first pixel.

18. The method recited in claim 12, wherein the first neighbor pixel has a color that is opposite a color of the first pixel and the object information is obtained by the acts of:

determining whether a first neighbor luminosity value of the first neighbor pixel is greater than a first pixel luminosity value of the first pixel;

defining the first pixel as black when the first neighbor luminosity value of the first neighbor pixel is greater than the first pixel luminosity value of the first pixel; and

defining the first pixel as white when the first neighbor luminosity value of the first neighbor pixel is not greater than the first pixel luminosity value of the first pixel.

19. The method recited in claim 1, wherein the first image includes a first non-coded object and a second non-coded object, the method further comprising the acts of:

receiving a second image that includes a third non-coded object and a fourth non-coded object, wherein the first image represents a first frame at a first point in time and the second image represents a second frame of a second point in time;

calculating a first sum of the distances between the first object of the first frame and the third object of the second frame and between the second object of the first frame and the fourth object of the second frame;

calculating a second sum of the distances between the first object of the first frame and the fourth object of the second frame and between the second object of the first frame and the third object of the second frame;

identifying the first object as being equivalent to the third object of the second frame when the first sum is less than the second sum; and

identifying the first object as being equivalent to the fourth object of the second frame when the second sum is less than the first sum;

20. A coded object that is configured to be scanned by a camera and included in an image that is received as input to a computer implemented coded object recognition program, the coded object comprising:

a first region that is represented as a first region image in the received image; and

a second region that is represented as a second region image in the received image, wherein the first region has an opposite color of the second region such that the coded object may be matched to a known coded pattern by determining whether a certain percentage of pixels within the second region image have a higher luminosity value than the first region image.

21. The coded object recited in claim 20, further comprising a third region that is represented as a third region image in the received image, wherein the third region has a same color as the second region such that the coded object may be matched to a known coded pattern by further determining whether a certain percentage of pixels within the third region image have a higher luminosity value than the first region image.

22. The coded object recited in claim 21, further comprising an angle region having an angle object that are represented as an angle region image having an angle object image in the received image,

wherein the angle region is mostly white except for the angle object such that a position of the angle object within the angle region may be determined by finding a pixel having the lowest luminosity value within the angle region image.

23. The coded object recited in claim 22, wherein the position of the angle object relative to the first region indicates the orientation of the coded object.

24. The coded object recited in claim 22, further comprising an identification object having an identifier position, wherein the position of the angle object relative to the first region indicates the identifier position, the identification object having a luminosity value that identifies the coded object.

25. The coded object recited in claim 24, wherein the color of the identification object is one of a group consisting of a first color and a second color such that when the color is the first color, the coded object is of a first object type and when the color is the second color, the coded object is of a second object type.

26. The coded object recited in claim 24, wherein the color of the identification object has a first portion and a second portion, the first portion having an opposite color of the second portion such that an identity of the coded object is determined by ascertaining which of the first and second portions is black and which is white.

27. The coded object recited in claim 20, further comprising an angle region having an angle object that are represented as an angle region image having an angle object image in the received image, wherein the angle object has a dark portion and a light portion and the angle region has a first half that is mostly white except for the dark portion of the angle object and a second half that is mostly black except for the light portion of the angle object such that a position of the angle object within the angle region may be determined by subtracting each pixel of the first half from each pixel in the second half and finding a minimum result.

28. The coded object recited in claim 27, further comprising an identification object having an identifier position, wherein the position of the angle object indicates the identifier position, the identification object having a color that identifies the coded object.

29. The coded object recited in claim 28, wherein the color of the identification object is one of a group consisting of a first color and a second color such that when the color is the first color, the coded object is of a first object type and when the color is the second color, the coded object is of a second object type.

30. The coded object recited in claim 28, wherein the color of the identification object has a first portion and a second portion, the first portion having an opposite color of the second portion such that an identity of the coded object is determined by ascertaining which of the first and second portions is black and which is white.

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